

New additions to Luxembourg's fen fly (Diptera: Syrphidae, *Neoascia*) fauna

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Abstract. New species records are valuable in informing conservation management and prioritising conservation measures, especially if the newly identified species are in peril. Here, we publish the first records of three hoverfly species of the genus *Neoascia* for Luxembourg, namely *Neoascia obliqua* Coe, 1940, *Neoascia unifasciata* (Strobl, 1898) and *Neoascia interrupta* (Meigen, 1822). *Neoascia unifasciata* is threatened with extinction, being listed as Endangered by the European Red List of hoverflies and the IUCN Red List of Threatened Species. Therefore, a conservation action plan has been developed for this species, which is now being implemented to preserve the populations of this hoverfly in Luxembourg and its habitats, which are stands of *Petasites hybridus*.

Key words. Insect conservation, hoverfly, conservation action plan, Luxembourg, new species records.

1. Introduction

Globally, 75% of all crops are pollinator-dependent, providing an estimated US\$ 300 billion in ecosystem services (IPBES, 2016). However, shifts in agricultural practices,

pollution, nitrification and the advance of invasive species has led to a decline both of specialised and even of widespread pollinators, including hoverflies (Biesmeijer et al. 2006; Gatter et al. 2020; Caspar et al. 2021; Hallmann et al. 2021). Recently, the Euro-

pean Union has adopted the Nature Restoration Regulation, which includes the aim to reverse declines of pollinators. A crucial step for halting and reversing pollinator declines is gathering information on the occurrence of populations of rare and threatened species to help identify priority areas for conservation action.

Out of the 201 hoverfly species documented in Luxembourg as of December 2024 (Reverté et al. 2023), four belong to the genus of fen flies or *Neoascia* Williston, 1886 (Table 1). Three species of fen flies – *Neoascia meticulosa* (previously *N. dispar*), *N. obliqua* and *N. podagrica* – may be migratory, having been recorded from migratory routes in the Bretolet pass in Valais, Switzerland (Aubert, 1976). The rest are sedentary with some species presumed to be specialized in larval food and habitat, making them vulnerable to the declines of their presumed host plant (*Petasites* sp. in the case of *Neoascia unifasciata*, *N. annexa* and *N. obliqua*) (Gatter & Schmid 1990, Biesmeijer et al. 2006; van der Ent et al. 2021a,d,e). The first records of *Neoascia* in Luxembourg date back to the 1950s when *Neoascia podagrica* (Fabricius, 1775) and *N. tenur* (Harris, 1780) were discovered by the Belgian entomologist Marcel Leclercq (Leclercq 1955, 1963). Between 1999 and 2001, Evelyne Carrières recorded (but not published) the species *N. meticulosa* (Scopoli, 1763) and *N. obliqua* Coe, 1940. Since then, *N. meticulosa* and *N. annexa* (although the origin of these records is unclear) were published by the most recent faunistic meta-study of Reverté et al. (2023).

The aim of our study was to test the hypothesis that *N. unifasciata* also occurs in Luxembourg because this species was classified as “possibly extant” for the country and listed as Endangered on the IUCN Red List of Threatened Species (van der Ent et al. 2021e).

2. Materials and Methods

To find potential habitats of *N. unifasciata*, we first searched Luxembourg’s biodiversity database (mdata.mnhn.lu) for sites with *Petasites hybridus* (L.) P. Gaertn., B. Mey.

& Scherb. the supposed food plant of the larvae of *N. unifasciata* and some other *Neoascia* species. Additionally, Luxembourgish naturalists were consulted for larger stands of this plant species. The identified sites were visited between May and July of 2023. *Neoascia* sp. were collected using hand nets, pan and Malaise traps and stored in 96% ethanol. A second sampling season was carried out between April and July of 2024. Samples from the 2023 sampling season are kept in the wet collection of the National Museum of Natural History of Luxembourg (Table 1 for their respective reference numbers), while the specimens from 2024 were identified and released in the field. All maps were generated using QGIS Desktop 3.30.2.

To aid species identification, a Keyence VHX-6000 digital microscope was used to magnify and capture diagnostic characters. Three complementary identification keys were used to identify members of the genus *Neoascia*. Barkemeyer & Claussen (1986) were the first to publish a complete identification key of European *Neoascia* species including *N. unifasciata* for the first time. In addition, two more recent identification keys of Northwest European species of *Neoascia* were used with some additional characters (van Veen 2014, Bot & Van de Meuter 2023).

3. Results

As a result of the targeted searches during the spring and summer of 2023 and 2024, we have confirmed the hypothesis that *N. unifasciata* is present in Luxembourg. Additionally, *Neoascia interrupta* has also been found for the first time while *N. obliqua*’s presence is confirmed and published here for the first time. With these new additions to the faunistic list of Luxembourg’s hoverflies, the country now has seven *Neoascia* species (Table 2). Furthermore, we confirmed the presence of *N. annexa* and *N. meticulosa*, whose first records in the country are ambiguous. The *Neoascia* species reported here were found in Luxembourg’s Gutland region, with the exception of one *N. meticulosa* specimen found in the North of the country in the Oesling region (Fig. 1).

Table 1. Records of *Neoascia* species from the museum collection. Species identifiers: FB = Franka Bernardi; NB = Nicki Bassing; HA = Hinatea Arie; WvS = Wouter van Steenis; FV = Francesco Vitali; EV = Evelyne Carrières; JT = Joana Teixeira; LCS = Lisette Cantu-Salazar; BA = Bálint András).

Species	No. specimens	Date	Lat	Long	Collection number	Identifier
<i>N. annexa</i>	1	1.6.2023	49.673698	5.935966	MNHNL150540	NB
	2	30.5.2023	49.67807	5.94145	MNHNL150504	FB
	6	6.6.2023	49.67807	5.94145	MNHNL150544	FB
	5	9.6.2023	49.67807	5.94145	MNHNL150511	FB
	5	13.6.2023	49.67807	5.94145	MNHNL150521	FB
	1	21.6.2023	49.67807	5.94145	MNHNL150541	FB
	1	29.6.2023	49.67807	5.94145	MNHNL150534	FB
	1	29.6.2023	49.67807	5.94145	MNHNL150525	FB
	2	29.6.2023	49.67807	5.94145	MNHNL150518	FB
	1	29.6.2022	49.67807	5.94145	MNHNL150547	FB
	1	29.6.2022	49.67807	5.94145	MNHNL150509	FB
	1	13.6.2022	49.67807	5.94145	MNHNL150543	WvS
	1	13.6.2023	49.67807	5.94145	MNHNL150549	FB
<i>N. interrupta</i>	2	31.7.2023	49.609420	6.123622	MNHNL130652	HA
	2	21.8.2023	49.757715	6.296481	MNHNL164540	HA
	1	5.5.2023	49.615661	6.132628	MNHNL164557	HA
	1	31.7.2023	49.60942	6.123622	MNHNL168634	HGR
<i>N. meticulosa</i>	1	6.7.2022	49.72810438	6.34714981	MNHNL164547	NB
	2	5.23.2022	49.72810438	6.34714981	MNHNL164313	HA
	1	10.4.2024	49.677074	6.086171	MNHNL128983	HA
	2	10.4.2024	49.714514	5.942603	MNHNL128985	HA
	4	22.6.2022	49.7281043	6.34714981	MNHNL165763	HA
	5	15.4.2024	49.595766	6.300121	MNHNL168260	HA
	1	31.5.2021	50.11448	5.93560	MNHNL168520	HA
	1	14.6.2021	50.11448	5.93560	MNHNL168962	HA
	5	22.5.2001	49.03	5.06	NA	EC
	2	10.5.2001	49.03	5.06	NA	EC
	1	11.5.2000	50.0502	5.98939	MNHNL67776	EC
	1	19.4.2001	49.03	5.06	MNHNL68690	EC
<i>N. obliqua</i>	1	20.5.1999	NA	NA	MNHNL138227	FV
	1	20.5.1999	NA	NA	MNHNL138228	FV
	7	4.5.2023	49.719003	6.093056	MNHNL150505	FB
	1	4.5.2023	49.719239	6.094956	MNHNL150572	NB
	1	6.5.2023	49.688229	5.89728	MNHNL150524	FB
	1	6.5.2023	49.688549	5.895047	MNHNL150582	FB

Species	No. specimens	Date	Lat	Long	Collection number	Identifier
	1	9.5.2023	49.590874	6.156195	MNHNL150506	FB
	4	11.5.2023	49.67807	5.94145	MNHNL150546	FB
	1	11.5.2023	49.674946	5.933657	MNHNL150508	NB
	4	18.5.2023	49.674374	5.933548	MNHNL150531	FB
	10	18.5.2023	49.674175	5.933696	MNHNL150539	NB
	4	18.5.2023	49.673805	5.934377	MNHNL150516	NB
	2	18.5.2023	49.673805	5.934377	MNHNL150512	NB
	2	18.5.2023	49.673698	5.935966	MNHNL150532	NB
	10	18.5.2023	49.672578	5.937386	MNHNL150507	FB
	1	23.5.2023	49.674374	5.933548	MNHNL150515	FB
	6	23.5.2023	49.674175	5.933696	MNHNL150530	FB
	2	23.5.2023	49.673805	5.934377	MNHNL150538	FB
	1	23.5.2023	49.673698	5.935966	MNHNL150573	FB
	2	25.5.2023	49.719003	6.093056	MNHNL150522	FB
	1	25.5.2023	49.719239	6.094956	MNHNL150574	FB
	1	1.6.2023	49.674175	5.933696	MNHNL150526	FB
	1	1.6.2023	49.673698	5.935966	MNHNL150523	FB
	1	1.6.2023	49.672578	5.937386	MNHNL150528	FB
	1	2.6.2023	49.719003	6.093056	MNHNL150527	FB
	1	6.6.2023	49.67807	5.94145	MNHNL150535	FB
	1	6.6.2023	49.674374	5.933548	MNHNL150503	FB
	1	9.6.2023	49.67807	5.94145	MNHNL150545	FB
	1	9.6.2023	49.673698	5.935966	MNHNL150529	FB
	1	21.6.2023	49.67807	5.94145	MNHNL150510	NB
	1	29.6.2023	49.674175	5.933696	MNHNL150519	FB
<i>N. podagrica</i>	1	3.9.2021	49.65560054	6.421787068	MNHNL128469	HA
	1	3.9.2021	49.54263061	6.34167619	MNHNL128472	HA
	2	20.9.2021	49.65560054	6.421787068	MNHNL128473	HA
	1	17.8.2023	49.72522803	6.265488379	MNHNL164538	HA
	1	20.7.2022	49.8096837	6.473402157	MNHNL164539	HA
	1	9.5.2022	49.72810438	6.34714981	MNHNL164292	HA
	1	5.8.2013	48.93083187	5.077499	MNHNL164545	NB
	1	3.5.2023	49.497371	6.282013	MNHNL164542	HA
	3	17.5.2023	49.4730691	5.9772380	MNHNL164543	HA
	1	2.5.2023	49.983104	6.012898	MNHNL164544	HA
	1	2.5.2023	49.981740	6.013661	MNHNL164546	HA
	2	19.7.2023	49.759116	5.827356	MNHNL128471	HA
	3	19.7.2023	49.762429	5.828052	MNHNL128474	HA

Species	No. specimens	Date	Lat	Long	Collection number	Identifier
	1	4.9.2023	50.0624639	5.8589346	MNHN164564	HA
	3	21.8.2023	49.757715	6.296481	MNHN164541	HA
	7	31.7.2023	49.609420	6.123622	MNHN164558	HA
	1	8.5.2023	49.6082649	6.1375138	MNHN164312	HA
	1	10.4.2024	49.677074	6.086171	MNHN128984	HA
	2	10.4.2024	49.714514	5.942603	MNHN128986	HA
	1	17.7.1998	NA	NA	MNHN138229	EC
	1	17.7.1998	NA	NA	MNHN138230	EC
	1	17.7.1998	NA	NA	MNHN138231	EC
	1	2.8.2019	49.484633	6.313222	MNHN138232	JT, LCS
	1	NA	NA	NA	MNHN138233	FV
	1	29.4.2024	49.552746	6.104772	MNHN165861	HA
	1	27.6.2024	49.775905	6.448987	MNHN165862	HA
	1	26.6.2024	49.82134	6.19962	MNHN165863	HA
	1	25.6.2024	49.650165	5.963687	MNHN165864	HA
	1	25.6.2024	49.558713	6.368558	MNHN165865	HA
	1	25.7.2024	49.622797	5.894801	MNHN165871	HA
	1	26.4.2024	49.748967	5.929174	MNHN164568	HA
	1	3.9.2024	49.663139	6.048172	MNHN164567	HA
	1	31.7.2024	49.632768	5.9476	MNHN166433	HA
	4	23.8.2024	49.863048	6.030104	MNHN165897	HA
	4	27.6.2024	49.782392	6.459915	MNHN165898	HA
	1	22.8.2024	49.907046	6.065953	MNHN165899	HA
	6	29.7.2024	49.734151	6.298025	MNHN165900	HA
	2	19.7.2024	49.843573	6.301813	MNHN165901	HA
	2	19.9.2024	49.906922	5.772804	MNHN165910	HA
	2	29.6.2023	49.642113	6.039879	MNHN165916	HA
	1	15.4.2024	49.595766	6.300121	MNHN168261	HA
	1	15.4.2024	49.595766	6.300121	MNHN168262	HA
	1	13.9.2023	49.7101297	6.265946701	MNHN168277	HA
	3	3.9.2024	49.663139	6.048172	MNHN168316	HA
	1	7.8.2024	50.03129	5.975841	MNHN168317	HA
	1	20.9.2021	49.64989784	6.417040564	MNHN168491	HA
	1	8.6.2022	49.72810438	6.34714981	MNHN168492	HA
	1	3.9.2021	49.65560054	6.421787068	MNHN168493	HA
	1	4.10.2021	50.11448	5.93560	MNHN168519	HA
	3	20.9.2021	50.11448	5.93560	MNHN168525	HA
	2	20.9.2021	50.09917	6.09697	MNHN168526	HA

Species	No. specimens	Date	Lat	Long	Collection number	Identifier
	1	20.9.2021	50.04253	5.90879	MNHNL168527	HA
	1	14.9.2021	50.02669	6.05942	MNHNL168528	HA
	3	20.9.2021	49.80040922	6.36977182	MNHNL168953	HA
	1	20.9.2021	49.81721501	6.35234799	MNHNL168955	HA
	3	20.9.2021	49.80040922	6.36977182	MNHNL168953	HA
	2	12.7.2021	49.80871861	6.29196571	MNHNL168954	HA
	1	4.10.2021	49.80040922	6.36977182	MNHNL168957	HA
	1	20.9.2021	49.80871861	6.29196571	MNHNL168958	HA
	1	4.10.2021	49.80871861	6.29196571	MNHNL168959	HA
	1	26.7.2021	50.11448	5.93560	MNHNL168960	HA
	3	26.7.2021	50.04253	5.90879	MNHNL168963	HA
<i>N. tenur</i>	3	7.9.2022	49.72810438	6.34714981	MNHNL164537	NB
	4	22.6.2022	49.72810438	6.34714981	MNHNL165764	HA
	1	14.6.2021	50.11448	5.93560	MNHNL168961	HA
<i>N. unifasciata</i>	4	11.5.2023	49.67807	5.94145	MNHNL150513	FB
	1	11.5.2023	49.674946	5.933657	MNHNL150581	NB
	11	30.5.2023	49.67807	5.94145	MNHNL150514	NB
	4	6.6.2023	49.67807	5.94145	MNHNL150536	NB
	3	9.6.2023	49.67807	5.94145	MNHNL150520	NB
	4	13.6.2023	49.67807	5.94145	MNHNL150537	NB
	5	21.6.2023	49.67807	5.94145	MNHNL150548	NB
	1	29.4.2024	49.679473	5.93989	No reference	BA
	1	29.4.2024	49.679448	5.939054	No reference	BA
	1	29.4.2024	49.679475	5.940088	No reference	BA
	2	29.4.2024	49.679296	5.940293	No reference	BA
	3	29.4.2024	49.678095	5.941215	No reference	BA
	4	14.5.2024	49.677946	5.9414708	No reference	BA
	1	14.5.2024	49.677967	5.941676	No reference	BA
	6	14.5.2024	49.678407	5.9411476	No reference	BA
	5	3.6.2024	49.677983	5.9417504	No reference	BA
	6	3.6.2024	49.677899	5.9416462	No reference	BA
	1	8.5.2024	49.67257	5.9369932	No reference	BA
	1	8.5.2024	49.672433	5.937414	No reference	BA
	1	7.5.2024	49.672195	5.9385563	No reference	BA
	2	7.5.2024	49.67224	5.9386404	No reference	BA
	2	28.5.2024	49.672568	5.936987	No reference	BA
	1	10.5.2024	49.688795	5.8959916	No reference	BA
	1	10.5.2024	49.68896	5.8960285	No reference	BA

Species	No. specimens	Date	Lat	Long	Collection number	Identifier
	1	6.6.2024	49.688146	5.8974015	No reference	BA
	1	30.4.2024	49.674002	5.934218	No reference	BA

Table 2. Records of *Neoascia* species from Luxembourg. * Bot & Van de Meutter 2023.

Scientific name	Common name*	Year of 1st record	Source of published 1st record
<i>Neoascia annexa</i>	Broad-banded fen fly	unknown	Reverté et al. 2023
<i>Neoascia interrupta</i>	Many-spotted fen fly	2023	This work
<i>Neoascia meticulosa</i>	Yellow-kneed fen fly	2000	Reverté et al. 2023
<i>Neoascia obliqua</i>	Butterbur fen fly	1999	This work
<i>Neoascia podagrica</i>	Smudge-veined fen fly	1955	Leclercq 1955
<i>Neoascia tenur</i>	Black-kneed fen fly	1955	Leclercq 1955
<i>Neoascia unifasciata</i>	Single-banded fen fly	2023	This work

A total of 73 adult *N. unifasciata* individuals (95% male) were captured around patches of *Petasites hybridus* on wet, calcareous soils (Fig. 2). All *Petasites* patches where *N. unifasciata* was found were larger than 1,300 m² (1,304; 1,348; 1,372; and 4,619, respectively). Most sites were bordered by paved roads on one side and a mosaic of *Petasites* meadows in alluvial situations on the other.

A total of six specimens of *N. interrupta* were found (84% female) at three different sites (Fig. 1). Four specimens were recovered from urban settings within Luxembourg City (Grund and Edith Klein Park). Two further specimens were found near a wetland in the North-East of Luxembourg. A similarity between these sites is their proximity to bodies of water, featuring nutrient rich, wet soils and wetland vegetation such as bulrush (*Typha* spp.), sedges (*Carex* spp.), and reeds (*Phragmites australis*).

The first two specimens of *N. obliqua* were captured by Evelyne Carrières in 1999 in Thillsmillen, Mamer. The individuals were recovered from the Mamer river valley in alluvial situations. In 2023, further 71 specimens (95% male) were found in Luxembourg City, Schendels, Koerich and Habscht (Fig. 1). All of them were found in alluvial

forests near waterways. The presence of *Petasites hybridus* at the collection sites is also notable, highlighting the reliance of this hoverfly on butterbur stands.

All thirteen *N. annexa* (100% male) individuals were found in Koerich in 2023, in alluvial forests of the Eisch river valley (Fig. 1). Even though this species was already listed as “Present” in Luxembourg by Reverté et al. (2023), we could not trace back the origins of this record in the published literature. It is likely based on an expert observation that was never officially registered.

The first eight records of *N. meticulosa* were made in 2000 and 2001 by Evelyne Carrières. Further 17 specimens (71% male) were found in Luxembourg between 2021 and 2023 as a result of the Hoverfly Atlas project. In Luxembourg, this is the most widely distributed amongst the above-mentioned species. Its distribution ranges from Troisvierges in the north to Canach in the south of the country (Fig. 1). With the records described above, seven *Neoascia* species are now documented in Luxembourg (Table 2), bringing the total number of hoverfly species in Luxembourg to 204.

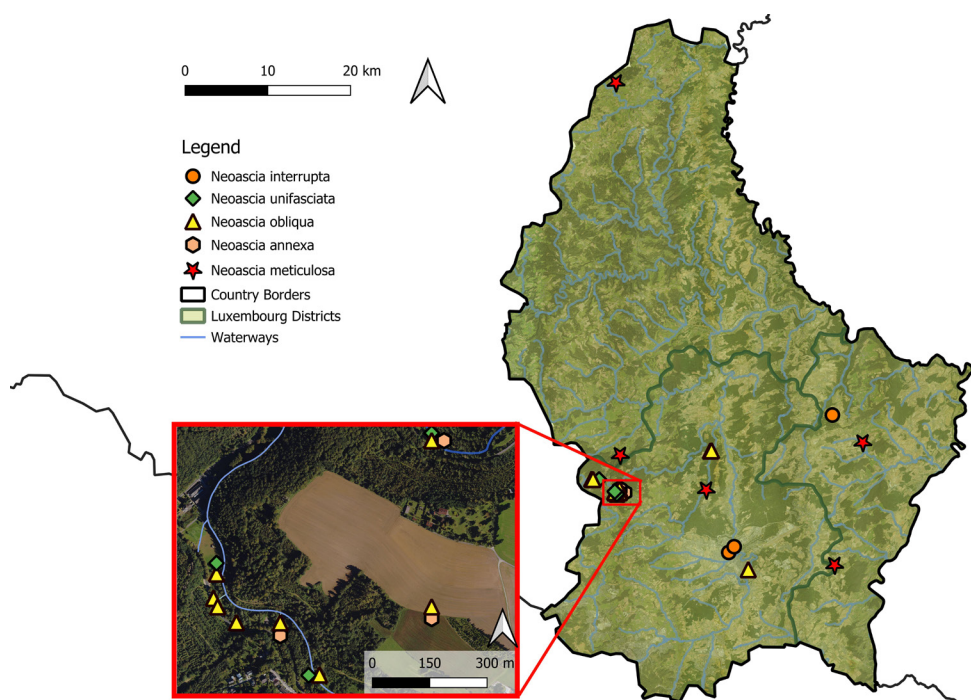


Fig. 1. Map of the first records of *Neoascia annexa*, *Neoascia meticulosa*, *Neoascia interrupta*, *Neoascia obliqua* and *Neoascia unifasciata* in Luxembourg (aerial and stream maps are taken from geoportail.lu).



Fig. 2. Typical habitat of the endangered hoverfly *Neoascia unifasciata*, new to Luxembourg. Other *Neoascia* species new to Luxembourg, such as *N. interrupta* and *N. obliqua* are also caught in wetlands, in alluvial forest edges and river valleys, where wet adapted plant species such as *Petasites hybridus* (shown in the photo above) occur. Photo: Franka Bernhardt.

4. Discussion

In this study, we were able to confirm the hypothesis that *N. unifasciata* occurs in Luxembourg. By searching in *Petasites* stands, we also found for the first time *N. interrupta* in Luxembourg. Furthermore, we confirm the presence of *N. annexa*, *N. meticulosa* and *N. obliqua* whose first records are either old or unpublished (such as *N. obliqua*), or – as in the case of *N. annexa* – have unconfirmed origin.

Species of the genus *Neoascia* share similar preferred habitats, as they are found in humid environments, near streams in wetlands, with alluvial vegetation (Speight et al. 2020, van der Ent 2021a–e). Similarly to most hoverflies, adults of *Neoascia* feed on different species of flowers, often with small flower heads. However, in contrast to the other two species, *N. annexa*, *N. unifasciata* and *N. obliqua* are only found in areas with butterbur stands, which they use as shelter and possibly as larval food source (Reemer et al. 2009, van der Ent 2021a,d,e). Notably, *N. unifasciata* (Fig. 3) is listed as Endangered on the IUCN Red List of Threatened Species, thus is in need of conservation action. Based on current knowledge, *N. unifasciata* larvae are likely to be specialised on *Petasites hybridus* plants. Therefore, conservation efforts need to be directed towards managing and creating healthy *Petasites* patches. In Luxembourg, major threats to the stands of butterbur are overgrowth with shrubs and trees, invasion of non-native plants, such as

knotweeds (*Reynoutria* sp.) and the drainage of wet meadows. Recently, beavers have colonized the area, increasing the risk of disturbing the habitat by felling trees, flooding or other habitat changes. However, the spread of the beaver might also increase potential habitat availability for the species, so that its impact must be carefully monitored. The most important habitat management options are removal of encroaching late-successional plant cover (shrubs and trees) and knotweed (*Reynoutria* sp.). In the long term, restoration of natural alluvial dynamics (particularly along the strongly regulated Giewelerbaach) will likely facilitate the spread of the habitat of the species. Further research is needed to develop specific and targeted conservation actions. For example, the minimum abundance of the host plant required to support populations of the three species of fen flies is unknown. Furthermore, the role of other environmental factors (e.g., shading by adjacent trees, soil type) for the occurrence of the fen-flies is yet to be studied in detail. Some level of shading is likely important for *N. annexa*, while *N. obliqua* and *N. unifasciata* appear to prefer more open habitats (L.-J. van der Ent pers. comm.). Furthermore, flowering plants adjacent to *Petasites* meadows are necessary as a food source for adult *Neoascia*. The implementation of the National Action Plan for the conservation of *N. unifasciata* will be crucial in halting further declines in their populations.

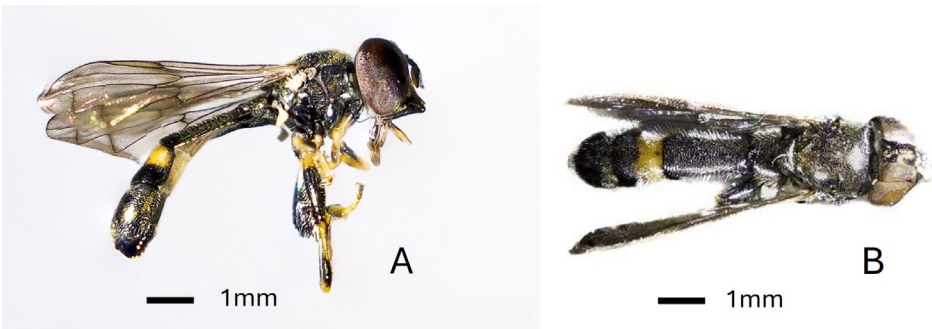


Fig. 3. Lateral (A) and dorsal (B) views of an adult male *Neoascia unifasciata*. The specimens were collected in May 2023, in wet soils near patches of butterbur (*Petasites hybridus*), using a hand net. Photo: Antonio Cruz.

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